Questioning questioning with student teachers

• Colin Forster • Jude Penny

Abstract

Questioning is seen as an essential teaching skill in primary science, but research reveals that many teachers ask too many questions and, particularly, closed questions, which impact negatively on children's intellectual engagement with scientific ideas. This article reports on research undertaken with final year undergraduate student teachers, in which they adopted elements of an action research methodology to examine their use of questions to promote children's observation and curiosity in primary science. Student teachers were astonished to discover how over-reliant they were on questions as their default strategy for engaging children in science-related dialogue, and identified specific ways in which their practice of questioning could be improved.

Introduction

This article reports on research undertaken with final year, undergraduate primary student teachers, focusing on the development of their ability to deploy carefully chosen questions in the teaching of primary science. The student teachers adopted elements of action research methodology to enable deep engagement with evidence-based evaluation of their practice.

The aims of the study were to:

- extend student teachers' understanding of quality questioning in primary science and its impact on children's intellectual engagement;
- challenge student teachers to examine the detail of their practice of questioning through a supported action research process; and
- develop student teachers' understanding of data analysis for improving practice.

There are many reasons why teachers of primary science may see questioning as an important aspect of their teaching practice: questions can be used to assess and evaluate children's ideas and progress, to promote scientific thinking, to encourage both dialogue and curiosity, and to support the management of tasks and pupil behaviour.

However, research suggests that teachers tend to ask too many questions; Carr (2002) estimates that teachers ask 22 questions per hour and Albergaria-Almeida (2010) cites estimates of 300-400 teacher questions per day. This dominance of discourse by teachers is seen as problematic by Wood (1998), who identifies that there is a negative correlation between the number of questions that teachers ask and the extent to which children can engage intelligently in a dialogue: *'frequent, specific questions tend to generate relatively silent children'* (Wood, 1998, p.175). This suggests that the more questions teachers ask, the less opportunity there is for children to engage in explicit higher-order thinking, and this is reflected in Ofsted's (2013) concern that many science lessons involve too much teacher talk that does not maintain pupils' natural curiosity or invite children's own questions.

In addition to asking too many questions, research suggests that many teachers over-rely on the use of closed questions (those with just one 'correct' answer), which tend to promote little intelligent response (Chin, 2006). Harlen (1999) suggests that such lower-order questions, requiring only factual recall, tend to dominate teachers' questioning, limiting opportunities for more creative and enriching thinking, while Oliveira (2009, p.424) identifies an *'apparent lack of sincerity in teachers' questions';* they are not genuinely seeking new information but merely aim to test children's knowledge.

Researchers suggest that providing 'thinking time' can enhance the number and quality of children's

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responses to teacher questions, with Rowe (1974) suggesting that children should be given up to ten seconds to respond to substantial, higher-order questions. It is worth noting that, just as it is important to provide thinking time for children after asking a question, it is equally important that teachers give *themselves* thinking time when responding to children's answers, ensuring that they have really listened to, and understood, what a child has said (Forster & Penny, 2020). Teachers, especially those new to the profession, can find both kinds of pauses rather awkward.

Research methods

In this study, action research was adopted as a guiding methodology to support the student teachers in their professional development. As identified by Forster and Eperjesi (2017), action research places an emphasis on the use of evidence as the basis for improving aspects of practice, in order to impact more positively on outcomes for learners. Interrogation of both the perceived *quality* of personal practice and, more importantly, the *impact* on the progress and development of learners enables teachers to challenge such assumptions and explore ways in which they might improve their teaching.

Final year, undergraduate primary student teachers were engaged in an exploration of the published research about questioning and dialogic teaching. They were encouraged to reflect on the reasons why asking lots of questions might limit children's ability to engage intelligently with scientific subject matter. They engaged in discussions about alternatives to asking questions when teaching, such as making statements, pausing or rephrasing the children's questions or comments. In a discussion about how many questions it is reasonable for teachers to ask, they suggested that, in a half hour lesson, a reasonable number of teacher questions might have an upper limit of fifteen.

Student teachers then worked in pairs to prepare a half-hour lesson for Year 2 children (ages 6-7) on the subject of plant germination and growth, using bean seeds at various stages of germination as their primary resource to promote observation and curiosity (Figure 1). In their planning, they identified questions that they might ask and, just as importantly, strategies they could deploy to avoid asking too many questions. In their pairs, the student teachers then taught their prepared lessons to small groups of Year 2 children. The interactions in each group were audio-recorded and transcripts were made to facilitate analysis.

Findings

After the teaching session, the student teachers completed an initial evaluation and noted key points for consideration:

- *It seemed that the children became quite reliant on our questioning.*
- *Overall, minimising the amount of questions used was proven to be difficult and we asked more questions than planned.*

Figure 1.

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- *We asked some POINTLESS QUESTIONS.*
- *We predict that we asked 80-100 questions between 3 student teachers during the 30 minutes of teaching!!*

The student teachers then had the opportunity to read through the transcripts (Figure 2) and ***analyse*** the speech in terms of:

- The balance of teacher/pupil talk.
- The number of questions they asked.
- The types and range of questions they used.
- Their 'best' questions.
- The children's 'best' responses/comments.
- The children's most limited responses.

They then aimed to **evaluate** their practice in terms of:

- Their most 'cringeworthy' moments.
- Suggestions for specific rephrasing of their questions or statements.
- Missed opportunities to develop the children's thinking.
- Improvements they might have made.

Figure 2.

In the following example, the children examined the bean seeds at different stages of growth.

Student teacher: How much older do you think this one is, compared to the first one?
Child A: Really older.
Student teacher: So talk in your partners. How much older? Is it a day older, a week older, a year older?
Child B: That will be six. That will be one.
Child C: That one is growing and that one is going to grow bigger.

In reviewing the transcript, this student teacher identified that she had taken the conversation down a 'dead end' by asking children to estimate the relative ages of the bean plants. It became an unproductive guessing game (much longer than the extract included here) and may have been more valuable had the children been invited to observe closely to identify any evidence that might help them to think about the stages of growth.

Throughout this process, the students were encouraged to use the principles of effective practice identified within the literature to inform their analysis and evaluation, through identifying alignment and dissonance with their own first-hand evidence. They then devised **specific action points** for next steps, which were based explicitly on their analysis.

Developing practice

The student teachers worked with the children once again. This time, they supported the children in observing some plant material under a microscope (Figure 3).

In this lesson, the student teachers applied their own learning, and were able to let the children lead discussions and, as a result, the children were given good opportunities to raise their own questions. Given that these were Year 2 children, the sophistication of their questions was

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Figure 3.

impressive, with the following questions being raised, among many others: *Why do plants close up sometimes? Why do plants have so many roots? Where do seeds come from? What are the hairs on the leaves for? Why are there a lot of lines on the leaf? Why do plants grow so slowly? Why do plants need leaves?* The questions were rich, authentic and excellent starting points for scientific enquiry.

Review

In the first stage of this enquiry, the student teachers were astonished to discover how over-reliant they were on questioning as their fallback strategy for engaging children in science-related dialogue, even following consideration of the limitations of questions and when making a particular effort not to ask too many questions. The process of analysing transcripts of their own interactions with children was highly significant in their evaluation of their practice. As a result, they were able to identify ways to develop their practice to have a greater impact on outcomes for children and to explore these in practice in the second teaching session.

Student teachers' realisations

As a conclusion to these learning episodes, we asked the student teachers to define, for the benefit of future cohorts, some key characteristics of effective questioning in primary science. These were presented as 'top tips' in order to elicit authentic responses that had emerged from the process that the students had experienced, and not what they perceived to be 'right answers' in terms of the features of effective questioning.

They suggested the following:

- Don't fill every silence with a question: enjoy silences.
- Don't dominate the children's thoughts.
- Allow children time to respond.
- Listen to children's responses.
- Use statements instead of questions: good statements can be just as good to promote thinking.
- Plan your questions beforehand.
- Ask the children if they have any questions: sit back and listen.
- Think before you ask!
- Have more confidence that children will make interesting comments without you drawing their attention to things.
- Allow time to really take in the children's comments before rushing to respond.

The suggestions highlight that, through reflective practice, the student teachers developed their pedagogical understanding of the importance of providing learners with opportunities to make meaning and be active contributors in the learning-teaching experience, as espoused by Bhutto and Chhapra (2013). In terms of teachers' questioning, the student teachers' suggestions offer practical approaches, which have the potential to address some of the limitations associated with a general over-reliance on questioning as the main communicative approach and they recognise the importance of offering meaningful responses to the children's answers, remarks and ideas.

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Conclusion

When student teachers were given the opportunity to analyse and evaluate both the perceived quality of their practice and, more importantly, its influence on the children's engagement and questioning, they responded with self-reflection, self-regulation, adaptations to their practice and changes to their subjective theories of the teacher's role in primary science. These experiences were transformative, because the student teachers intended to enact their professional learning in their future practice.

This study has shown that engaging student teachers in the process of action research can lead to deep professional learning, which is likely to have a positive impact on the quality of their practice and promote the intellectual engagement of children.

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